Evaluation of Web Applications Through Simulation of Web Designs

by

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Thesis

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CERTIFICATE OF AUTHORSHIP/ORIGINALITY

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledge within the text.

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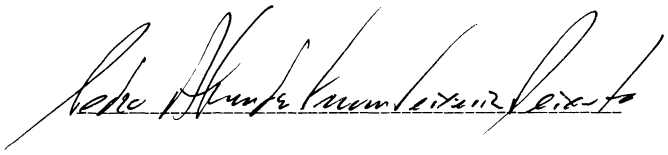

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Glossary

ACM – Association for Computing Machinery

Functional requirement – A description of a function a system or system component must be able to perform (*IEEE standard glossary of software engineering terminology – 610.12-1990* 1990)

Functional Content – Measure used in this research for the evaluation of each treatment and defined as the observable factors a treatment provides and their structure and value

Functional Information – Measure used in this research for the evaluation of each treatment and defined as the level of contribution of the observable factors for the evaluation of functional requirements

HDL – Hardware Description Language (Garzotto et al. 1991*b*)

HDM – The Hypertext Design Model (Garzotto et al. 1991*b*)

IEEE – Institute of Electrical and Electronics Engineers

OOHDM – The Object-Oriented Hypermedia Design Model (Schwabe and Rossi 1995*a*)

Prototyping – A development technique that uses a preliminary version of part or all of the software product for user feedback, feasibility evaluation, or other issues supporting the development process (*IEEE standard glossary of software engineering terminology – 610.12-1990* 1990)

RMM – The Relationship Management Methodology (Isakowitz et al. 1995)

Simulation – "(1) A model that behaves or operates like a given system when provided with a set of controlled inputs. (2) The process of developing or using a model as in (1)." (*IEEE standard glossary of software engineering terminology – 610.12-1990* 1990)

Software Development Cycle – The period of time ranging from the start of the software product project to its delivery (*IEEE standard glossary of software engineering terminology – 610.12-1990* 1990)

Software Life Cycle – The period of time ranging from the conceptualization of the software product project to when it is no longer available (*IEEE standard glossary of software engineering terminology – 610.12-1990* 1990)

SRS – System Requirements Specification

UIM – The proposed User Interaction Model

UML – The Unified modelling Language (OMG 2005)

Use cases – capture *who* (actor) does *what* (interaction) with the system, for what *purpose* (goal), without dealing with system internals. A complete set of use cases specifies all the different ways to use the system, and therefore defines all behaviour required of the system, bounding the scope of the system (Malan and Bredemeyer 2001)

Validation – Confirmation by examination and provisions of objective evidence that the particular requirements for a specific intended use are fulfilled (*IEEE standard for software verification and validation – 1012-1998* 1998)

Verification – Confirmation by examination and provisions of objective evidence that specified requirements have been fulfilled (*IEEE standard for software verification and validation – 1012-1998* 1998)

VHDL – VHSIC Hardware Description Language (VHSIC being an acronym for Very High-speed Integrated Circuit) (*IEEE Standard VHDL Language Reference Manual – 1076* 2002)

WAD – A Web Application Design. A high-level description of how a system is organized and operates, usually using one or more Web Application Design Models. It shows the objects or object classes in a system and, where appropriate, the relationships between these entities (Sommerville 2004)

WADM – A Web Application Design Model. Allows the representation of the result of the design activity by providing a framework or language which can be used to compare and document the specifications of applications (Lowe and Hall 1999)

Web Engineering – Web engineering is the establishment and use of sound scientific, engineering and management principles and disciplined and systematic approaches to the successful development, deployment and maintenance of high quality Web-based systems and applications (Murugesan et al. 1999)

WebML – The Web Modeling Language (Ceri et al. 2000)

WDL – The developed Web-design Description Language

WSM – The proposed Web-design Simulation Model

Abstract

Evaluation of Web Applications Through Simulation of Web Designs

The development of Web applications continues to pose numerous difficulties for Web developers due to the inherent complexity of the projects. Although methodologies have been proposed to tackle the development of these projects, they are especially concerned with setting guidelines and defining tasks to better structure the design phase. For this purpose, several design models have been developed and used in the design of Web applications, providing a suitable level of abstraction and independence from a specific implementation. However, the other phases of the Software Development Cycle have not received the same level of attention from researchers. In particular, the test phase is lacking in theory and tools to effectively and efficiently verify the project requirements. Evaluation of the functional requirements of a system under development is commonly done by its partial implementation and test. This requires the development and coding of a prototype

of the system to be able to verify the design. Furthermore, this prototyping effort could be partially or totally in vain if tests find that the design does not meet the intended requirements.

This research argues that it is possible to simulate Web application design models for the verification of functional requirements. Furthermore, it claims that simulation is able to provide as much functional information as an implementation would. The research proposes a multi-layer Web-design Simulation Model, which was developed to enable simulation of Web application designs and takes into consideration developers' key design concerns. Furthermore, a Web-design Description Language was especially developed to provide meaningful simulation of design models. It borrows concepts from the hardware engineering field where simulation is extensively used for design verification. By performing simulation directly on the designs, the need for prototyping for functional evaluation is reduced or no longer necessary and verification of the requirements can be performed as soon as a design is available. This has the potential to contribute to a faster Software Development Cycle of Web applications.

To prove the feasibility of the simulation and the meaningfulness of its application, an experiment on a selected Web application design was conducted. This entailed a comparison between the implementation and simulation results for the functional requirements evaluation. The comparison was performed by assessing the functional content and information of the results that both methods provided. The comparison showed that, although both are suitable for verification of functional requirements, the proposed Simulation Model provides additional functional information and a more intuitive analysis for the evaluation of Web application designs.